REBUTTAL TESTIMONY OF

MATTHEW W. TANNER, Ph.D.

ON BEHALF OF

DOMINION ENERGY SOUTH CAROLINA, INC.

DOCKET NO. 2019-184-E

Q. PLEASE STATE YOUR NAME AND BUSINESS ADDRESS.

A. My name is Matthew W. Tanner. My business address is 1200 19th St. NW, Suite 700, Washington, DC 20036.

Q. ARE YOU THE SAME MATTHEW TANNER THAT OFFERED DIRECT TESTIMONY IN THIS DOCKET?

A. Yes, I am.

Q. WHAT IS THE PURPOSE OF YOUR REBUTTAL TESTIMONY?

A. The purpose of my rebuttal testimony is to discuss the response of Dominion Energy South Carolina, Inc. ("DESC" or the "Company") to certain issues raised in 1) the direct testimony of Mr. Brian Horii filed on behalf of the South Carolina Office of Regulatory Staff ("ORS"); 2) the direct testimony of Mr. Derek P. Stenclik filed on behalf of the South Carolina Coastal Conservation League and the Southern Alliance for Clean Energy (collectively, "CCL/SACE"); and 3) the direct

testimony of Mr. Ed Burgess filed on behalf of the South Carolina Solar Business Alliance.

REBUTTAL TO TESTIMONY OF MR. BRIAN HORII

Q. WITH RESPECT TO MR. HORII'S TESTIMONY, PLEASE EXPLAIN HOW YOU ORGANIZE YOUR RESPONSES.

A. My rebuttal testimony sequentially addresses certain issues raised by Mr. Horii as they appear in his direct testimony.

Q. ON PAGE 10, LINE 19 THROUGH PAGE 13, LINE 14, MR. HORII STATES THAT THE ASSUMPTIONS USED BY NAVIGANT TO ESTIMATE RENEWABLE INTEGRATION COSTS OVERSTATE THE RISKS OF UNCERTAIN VARIABLE GENERATION TO THE COMPANY. HOW DO YOU RESPOND TO THIS POSITION?

A. I disagree that the assumptions underlying the Variable Integration Cost (VIC) Study overstate the risks of variable generation to the company. The study properly considers the tradeoff between risk of solar undergeneration and the likelihood of it occurring. The threshold used for representing the risk of solar undergeneration is appropriate for the VIC calculation. The reserve requirement modeling for the entire day is an aspect of modeling that does not conservatively bias the results because the make-up of the DESC system is such that large numbers of reserves are always available overnight. During times when large numbers of

reserves exist already, increasing reserve requirements due to solar has no impact on modeling results, since sufficient capacity is available to meet demand efficiently with or without taking into account additional reserve requirements. To account for any impact that might result from day-to-day changes in solar generation and reserve requirements, I model different cases with different reserve requirements and blending them together to capture the effect about which Mr. Horii seems to be concerned.

Q. ON PAGE 11, LINES 5 THROUGH 7 AND ON PAGE 11, LINE 12 THROUGH PAGE 12, LINE 23, MR HORII SUGGESTS THAT DESC FAILED TO CONDUCT AN ANALYSIS THAT BALANCES RISKS AND COSTS TO DETERMINE THE AMOUNT OF OPERATING RESERVES NEEDED AS A RESULT OF VARIABLE SOLAR RESOURCES. DO YOU AGREE?

A. No. Navigant's analysis did not use the absolute maximum in potential solar undergeneration to estimate the amount of reserves that need to be held. In order to avoid the most extreme events in the data set, the analysis used a threshold of rounding to 1%. This threshold was chosen specifically to balance the risk reduction vs. the cost of holding the additional reserves needed to integrate the solar generation. This is very far from an analysis of what it would take to mitigate all risks. In electric system operations, 1% can be a very meaningful risk.

Q. ON PAGE 13, LINE 20 THROUGH PAGE 16, LINE 1, MR. HORII RECOMMENDS CERTAIN MODIFICATIONS REGARDING THE SOLAR FORECAST UNCERTAINTY WHICH IS A PART OF YOUR COST OF INTEGRATION STUDY. DO YOU AGREE WITH HIS RECOMMENDATIONS?

A. No, the key assumption modification suggested by Mr. Horii is to use a 2% threshold for solar undergeneration vs. a 1% threshold. During the daylight hours, solar is capable of generating electricity approximately 4,000 hours per year. Using a 1% threshold as the estimate of solar uncertainty reflects an expectation that DESC would have an insufficient amount of generation due to unanticipated loss in solar generation approximately 30 to 50 hours per year. In electric generation planning, it is appropriate and good practice to use relatively unlikely events as the basis for determining the needed level of reserves to ensure that any undergeneration can be replaced without disrupting service to customers. Unanticipated losses of solar generation are guaranteed to occur. But when these unanticipated losses in solar generation will occur cannot be predicted. Whether there will be capacity on the system at the time to respond to them without disrupting service to customers is uncertain. Therefore, Navigant determined that assuming a 1% level of solar uncertainty provides the appropriate tradeoff between the cost of holding more reserves and mitigating risk from undergeneration.

Q. ON PAGE 16, LINE 2 THROUGH PAGE 18, LINE 6, MR. HORII IDENTIFIES THE OUTCOMES OF HIS CALCULATIONS REGARDING SOLAR FORECAST UNCERTAINTY AND STATES THAT HIS FINDINGS ARE MORE REASONABLE THAN THOSE INCLUDED IN THE NAVIGANT INTEGRATION STUDY. DO YOU AGREE?

A. No, Navigant's study assumptions were developed to properly consider risk vs. the cost of holding reserves. Mr. Horii suggests a threshold that would result in a higher level of risk to the DESC system. While his threshold does result in a lower variable integration charge calculation, I believe that it would result in too much risk to reliability for DESC and its customers.

Q. ON PAGE 11, LINES 10 THROUGH 11, AND ON PAGE 22, LINE 2 THROUGH PAGE 23, LINE 10, MR. HORII EXPRESSES CONCERN THAT NAVIGANT'S INTEGRATION STUDY OVERSTATED RESERVE NEEDS BY HOLDING RESERVE LEVELS CONSTANT THROUGHOUT EACH DAY OF THE YEAR. DO YOU BELIEVE HIS CONCERNS ARE REASONABLE?

A. No. In nighttime hours, DESC has more than enough reserves available from thermal units that are operating at less than full capacity. It can rely on ramping these units up as needs require, while using the fast-start capabilities of its Combustion Turbines as well. (Except at winter peaks, Combustion Turbines are rarely in use at night and so are available as reserves.). The Fairfield Pumped

Storage plant also would be available to provide reserves during these nighttime hours. Thus, in the hours when the sun is not shining, the model shows that average reserves held on DESC's system are over 1,500 MW. By contrast, the planning model only required that 240 MW be held in the business-as-usual (i.e., non-solar) reserves case. This means that the additional reserves required for solar integration are not a binding constraint on the system in non-solar hours and thus do not materially impact the overall system operating costs or contribute to the calculation of the Variable Integration Charge ("VIC").

Q. ON PAGE 27, LINES 21 THROUGH 22, AND ON PAGE 28, LINE 18 THROUGH PAGE 29, LINE 4, MR. HORII SUGGESTS THAT THE COMPANY'S MODELING REQUIRES OPERATING RESERVES TO PROVIDE SOLAR INTEGRATION SERVICES INSTEAD OF POTENTIALLY LOWER COST TYPES OF RESERVES. HOW DO YOU RESPOND TO THIS SUGGESTION?

A. It is important to carefully define what is meant by operating reserves in the context of modeling the impacts of variable generation on system operation. There are multiple types of reserves that must be held. Each type of reserves has different costs and requirements for the assets that are providing them. Carefully distinguishing between these different types of reserves and the costs they reflect is important.

- Planning reserves – These are additional generation reserves that must be available to safely meet peak demand given load uncertainty and risks of outages. A resource that provides planning reserves must generally be able to generate during peak periods – for that reason adding solar to a system does not increase the need for planning reserves. As it keeps being added, the capacity contribution of solar decreases and other resources are needed to make up the gap.
- Contingency reserves – These are short-term reserves held so the Balancing Authority can respond to an unexpected generation plant outage. These reserves are tied to the largest contingencies under NERC standards which are generally the loss of the single largest generator on the system or under a load sharing agreement on the systems of utilities that are parties to that agreement. The requirement for contingency reserves does not change with additional solar generation.
- Flexible reserves – These are short-term reserves held so that the system can respond to unexpected reductions (or increases) in non-dispatchable generation or customer load. Flexible reserves are the reserves that must increase in order to accommodate solar generation because solar generation is intermittent and unpredictable in important ways. The reserves that the Navigant study added to the PROMOD model to quantify the avoided cost impact from solar generation are flexible reserves which are the reserves needed to adjust to solar intermittency.

- Regulating reserves –These are very short-term reserves generally made up of resources on Automatic Generation Control ("AGC"). AGC devices are automatic devices that signal generators to increase or decrease their output to maintain a balanced system. These reserves are generally held in order to maintain load and generation balance on a minute-to-minute basis. It has been observed that increased renewable generation within the expectations on the DESC system does not increase the regulating reserve requirement and they would not be expected to. The impact of solar intermittency is captured in flexible reserves, not regulating reserves. Regulating reserves tend to be the highest cost reserves to hold.

Operating reserves is a more general term for all reserves that are needed to operate the system. Contingency, flexible, and regulating reserves can all considered as subsets of operating reserves.

REBUTTAL TO TESTIMONY OF MR. DEREK STENCLIK

Q. WITH RESPECT TO MR. STENCLIK'S TESTIMONY, PLEASE EXPLAIN HOW YOU ORGANIZE YOUR RESPONSES.

A. In the same manner I responded to Mr. Horii's testimony, my rebuttal testimony sequentially addresses certain issues raised by Mr. Stenclik as they appear in his direct testimony.

Q. ON PAGE 4, LINES 5 THROUGH 7, MR. STENCLIK STATES THAT THE NAVIGANT STUDY INCORRECTLY ANALYZES SOLAR DATA AND THEREFORE OVERSTATES THE ASSOCIATED UTILITY RESERVE REQUIREMENTS IN HIS MODELING. HOW DO YOU RESPOND TO HIS TESTIMONY?

A. I disagree. The Navigant Study uses a generally accepted method for calculating the forecast error of solar generation using a data set provided by the U.S. Government's National Renewable Energy Lab (NREL) that was created for the purpose of renewable integration studies. Furthermore, Navigant took care with the study design to avoid overstating reserve requirements, ensuring that geographic diversity of solar generation was fully included in the analysis, and that the risk vs. cost of holding additional reserves was appropriately considered.

Q. ON PAGE 5, LINE 12, MR. STENCLIK CLAIMS THAT OFFLINE COMBINED CYCLE UNITS WERE NOT ALLOWED TO PROVIDE RESERVES IN THE STUDY DESPITE THE 4 HOUR FORECAST ERROR. IS THIS TRUE?

A. This is not true. Combined cycle gas units can provide reserves as long as they are operating. They are not allowed to provide reserves when they are offline. When modeling the DESC system, this aspect of combined cycle operation was appropriately considered. One of the potential system changes that the model represents when additional reserves are added to the system is that combined cycle

units can be turned on in the model and then will be operating and able to provide reserves when needed in real-time. This is one of the potential drivers of system cost increases in the model.

Q. ON PAGE 5, LINE 17 THROUGH PAGE 6, LINE 7, MR. STENCLIK IDENTIFIES CERTAIN CONCERNS WITH THE STUDY, INCLUDING THAT ADDITIONAL FIXED SOLAR RESERVE REQUIREMENTS WERE IMPOSED FOR EACH HOUR OF THE YEAR RATHER THAN BEING A FUNCTION OF HOURLY FORECASTED SOLAR GENERATION. DO YOU AGREE WITH HIS CONCERNS?

A. No, I discuss this point in my response to Mr. Horii on this topic. Because of the amount of capacity that is available at night, requiring additional reserves at night does not materially change system economics and to the extent any change occurs at all, it is captured by blending multiple reserve assumptions as the Navigant study has done.

Q. **ON PAGE 5, LINE 21, MR. STENCLIK STATES THAT THE STUDY FAILED TO INCLUDE THE FULL CAPABILITIES TO PROVIDE RESERVES FROM FAIRFIELD PUMPED STORAGE AND INTERRUPTIBLE LOAD. DO YOU AGREE?**

A. No. As I discussed in my direct testimony, PROMOD allowed the Fairfield Pumped Storage plant to change its operation to minimize overall system cost while

meeting the flexible reserve requirements for solar integration. Accordingly, the model used in the study configured Fairfield to provide flexible reserves both when it is pumping and when it is offline. As discussed in the rebuttal testimony of Company Witness Bell, regarding interruptible load, the Company believes that relying upon interruptible load to meet daily operating reserve (contingency and flexible) requirements would significantly increase the number of curtailments and result in substantial additional economic impacts to interruptible customers. Therefore, it is appropriate to assume that only 100MW of interruptible load can count towards the contingency reserves and no extra interruptible load can count towards the flexible reserves needed for renewable integration.

Q. ON PAGE 7, LINES 8 THROUGH 17, MR. STENCLIK STATES THAT DESC FAILED TO EVALUATE LESS COSTLY METHODS OF INTEGRATING LOW-COST RENEWABLE RESOURCES. IS HE CORRECT?

A. No, the Navigant study looked in depth at the costs for DESC to add a gas-fired peaking facility or storage to the system to provide flexible reserves for renewable integration. Both of these were excluded as too expensive. It is not appropriate to consider other benefits of those projects because DESC does not need any new resources at the moment and so these would be added solely to integrate renewable power.

The study does consider the option for new solar resources to include on-site flexibility. It would be appropriate for DESC to allow solar projects to operate more flexibly, or to provide co-located storage as long as the capabilities of the projects was sufficient for DESC to use them to reduce flexible reserves requirements and avoid additional system costs from solar integration. In these scenarios it is highly likely that aspects of the contracts with DESC for these resources would need to be modified in order to ensure that the necessary flexibility is being provided to the system.

Finally, Mr. Stenclik argues that DESC should have considered implementing a larger balancing area. This cannot be feasibly done in the short-term. DESC's balancing area is its service territory. Implementing a larger balancing area would require multiple years of study and negotiation with surrounding utilities and states.

Q. ON PAGE 6, LINES 18 THROUGH 21, MR. STENCLIK TESTIFIES THAT IT IS A FUNDAMENTAL FLAW TO TARGET THE VIC TO A SPECIFIC TECHNOLOGY. DO YOU AGREE WITH HIS CONCERN?

A. No, the VIC is charged to variable resources based on their particular operating characteristics and pattern of generation. It is those operating characteristics and pattern of generation that define the flexible reserves needed to account for the particular type of intermittency risk posed by that specific variable resource. Therefore, the VIC is specific to each type of resource. The Navigant

Study focused on solar because that is the variable generating technology that is being added to the system.

Q. ON PAGE 7, LINES 15 THROUGH 22, MR. STENCLIK STATES THE NAVIGANT STUDY HAS A NUMBER OF PROBLEMS AND THAT IT MAY IMPOSE UNNECESSARY AND EXCESSIVE FUEL AND RESERVE COSTS ON AN ONGOING BASIS. WHAT IS YOUR RESPONSE TO THIS STATEMENT?

A. The Study was carefully designed to properly evaluate the operational changes and costs to the DESC system as variable solar is added to the system. Variable generating resources do require additional flexible reserves. Maintaining these flexible reserves also requires operational changes that increase operating costs for the Company compared to how the system would operate without those additional flexible reserve requirements. The VIC is a calculation of those costs.

Q. ON PAGE 8, LINE 1 THROUGH PAGE 10, LINE 12, MR. STENCLIK STATES THAT SOLAR VARIABILITY AND FORECAST ERRORS DO NOT POSE RELIABILITY RISKS TO DESC AND THAT OTHER GRID OPERATORS HAVE SUCCESSFULLY INTEGRATED VARIABLE RENEWABLE ENERGY WITHOUT SIGNIFICANT INCREASE IN RESERVE REQUIREMENTS. HOW DO YOU RESPOND?

A. Utilities that operate a Balancing Area, must maintain resource sufficiency. That is standard operating procedure and a reliability requirement. It is inappropriate and not standard procedure to rely on the broader power system for reliability without formal agreements in place. Utilities cannot unilaterally shift their reliability requirements onto their neighbors.

Mr. Stenclik's claim that other grid operators have successfully integrated variable renewable energy without a significant increase in reserve requirements is not a true statement. Mr. Stenclik appears to be conflating regulating reserves with flexible or operating reserves. Regulating reserves are held with resources that can respond to system operator dispatch on a minute-by-minute or even second-by-second basis to balance the system. Renewable generation has been observed to not significantly impact the need for regulating reserves, so it is not at all surprising to say that other grid operators have successfully integrated variable renewable energy without a significant increase in regulating reserves. The same is not true of flexible reserves. The flexible reserve requirement forecasted in the VIC study is for resources that can respond to unexpected undergeneration from solar. Regions like CAISO and ERCOT have increased their requirements for these types of reserves, or changed their energy market procurement rules or market structures to account for them. But the operating realities and the fact that there are costs that must be borne are the same.

REBUTTAL TO TESTIMONY OF MR. ED BURGESS

Q. WITH RESPECT TO MR. BURGESS' TESTIMONY, PLEASE EXPLAIN HOW YOU ORGANIZE YOUR RESPONSES.

A. In the same manner I previously responded to the testimony of the other parties' witnesses, my rebuttal testimony sequentially addresses certain issues raised by Mr. Burgess as they appear in his direct testimony.

Q. ON PAGE 65 THROUGH PAGE 70, MR. BURGESS SUGGESTS THAT IT IS INAPPROPRIATE TO MODEL THE DESC SYSTEM AS A PARTIALLY ISLANDED SYSTEM. DO YOU AGREE?

A. No. The Study is focused on operational changes that DESC needs to adopt in order to maintain reliability given the variability of solar resources. As a utility that operates a Balancing Area, DESC is obligated to maintain self-sufficiency in planning. It is inappropriate to assume that surrounding utilities will have available resources ready to support DESC's Balancing Area, should a reliability event occur due to solar intermittency which DESC is responsible for it its planning.

Mr. Burgess suggests that because there is power and capacity trading between DESC and surrounding utilities, this shows that the partially islanded system assumption should not be used. These trades are economic in nature, and does not indicate that other utilities are taking responsibility to ensure that DESC has the resources needed to support reliability on its system. Voluntary exchanges of power and capacity are a separate issue from the resource availability

assumptions in a reliability planning study. While DESC does trade with surrounding systems, this activity is generally for economic opportunity, and does not have a reliability component. DESC does not rely on short-term trades for any long-term reliability planning.

Q. ON PAGE 69 THROUGH PAGE 70, MR. BURGESS SUGGESTS THAT DESC SHOULD COMBINE BAAS OR EXPAND A RESERVE SHARING AGREEMENT FOR RENEWABLE INTEGRATION. DO YOU AGREE?

A. Either of these options would likely provide benefits with renewable integration. However, neither is quick, easy or cheap to implement. Combining Balancing Areas or expanding reserve sharing agreements would require a large, long-term effort in evaluating the impacts of the change and then a likely larger effort to negotiate and implement the agreement. Doing so will require coordination with multiple utilities and stakeholders and likely would raise important legal issues. Such changes are well beyond the scope of the issues in the Navigant study..

Q. ON PAGE 71 THROUGH PAGE 75, MR. BURGESS STATES THAT THE NAVIGANT STUDY DOES NOT PROPERLY CONSIDER GEOGRAPHIC DIVERSITY. DO YOU AGREE?

A. No. In some cases, geographic diversity may be a significant driver of reductions in volatility in solar generation and the study is careful to ensure that geographic diversity was properly considered. For the volatility analysis, the study

examined four projects spread as widely as possible across the DESC service territory. Four locations is an appropriate number, as the mechanism for geographic diversity reducing volatility is the diversity in the weather that drives solar generation. Due to the small size of DESC's service territory, there is a material limit to the ability for geographic diversity to reduce overall generation variability of the solar fleet.

Q. ON PAGE 76 THROUGH PAGE 77, MR. BURGESS SUGGESTS THAT A 2 HOUR FORECAST WINDOW IS MORE APPROPRIATE TO USE THAN A 4 HOUR FORECAST WINDOW AND THAT IF A 4 HOUR WINDOW IS USED THEN OFFLINE CCS SHOULD BE CONSIDERED AS PROVIDING OPERATING RESERVES. DO YOU AGREE?

A. No. The 4 hour-ahead forecast is provided by NREL in a dataset created specifically for renewable integration studies. It is appropriate to use this dataset for evaluating the forecast error faced by DESC.

In regard to offline CCs providing reserves, I believe Mr. Burgess's statement is the result of a misunderstanding of how production cost models work. A CC can only provide operating reserves if it is operating and has the immediate capability to ramp up. This fact is properly represented in the production cost model and the study. However, it is not true that CCs are not allowed to provide reserves in the study. If starting CCs to provide reserves is the most cost-effective solution,

the production cost model will start up CCs in order for them to be providing reserves in the hour they are needed.

Q. ON PAGE 77 THROUGH PAGE 79, MR. BURGESS SUGGESTS THAT CHANGES IN RESERVE REQUIREMENTS BY TIME PERIOD WERE NOT PROPERLY CONSIDERED IN THE STUDY. DO YOU AGREE?

A. No, I discuss this point in my response to Mr. Horii on this topic. Because of the amount of capacity that is available at night, requiring additional reserves at night does not materially change system economics and to the extent any change occurs at all, it is captured by blending multiple reserve assumptions as the Navigant study has done.

Q. ON PAGE 63, LINES 1 THROUGH 3, AND ON PAGE 86, LINES 4 THROUGH 17, MR. BURGESS TESTIFIES THAT DESC'S PROPOSAL DOES NOT CONSIDER INTEGRATION SERVICES THAT COULD BE PROVIDED BY SOLAR QFs. IS HE CORRECT?

A. There are methods by which solar projects can provide flexibility to the system either by operating differently or by co-locating storage. The VIC study only considered solar projects that are not providing flexibility. There is some discussion of the characteristics of solar projects that would be necessary to avoid the VIC. The details of what those projects would need to do in order to fully avoid the VIC still

needs to be defined. Given this, the recommended VIC should only be applied to solar projects that are not providing any flexibility.

Q. ON PAGE 63, LINES 4 THROUGH 6, MR. BURGESS STATES THAT THE VIC IS LINKED TO A HYPOTHETICAL MODEL RATHER THAN REAL-WORLD COSTS. HOW DO YOU RESPOND TO HIS ASSERTION?

A. Integrating variable resources does require system operation to change in a way that increases costs. The Study was designed to provide a methodology to estimate the system operation changes and the resulting costs. The Study input assumptions are set up to match real-world operation and the model was benchmarked to the DESC system. Once real-world operations are known and benchmarked, it is necessary and standard practice to use simulation models to calculate the impacts of changes to system operation such as the requirements to integrate renewable power. It is entirely appropriate and standard practice across North America to base electric rates and values on the results of these simulation models.

Q. ON PAGE 84 THROUGH PAGE 85, MR. BURGESS PROVIDES DATA FROM CAISO THAT SHOWS THAT REGULATING RESERVE REQUIREMENTS HAVE NOT INCREASED AS SOLAR GENERATION HAS INCREASED. IS THIS RELEVANT TO DESC'S SOLAR INTEGRATION COST ESTIMATES?

A. No. Mr. Burgess is conflating regulating reserves and flexible reserves. It is true that renewable generation has been observed to not significantly impact the need for regulating reserves. The same is not true of flexible reserves. Regions such as CAISO and ERCOT have been observed to increase their requirements or change their market structure to increase system flexibility for integrating renewables.

Q. ON PAGE 90, LINES 12 THROUGH 13, AND ON PAGE 93, LINE 17 THROUGH PAGE 94, LINE 16, MR. BURGESS STATES THAT THE VIC SHOULD BE ABLE TO BE MITIGATED THROUGH APPROPRIATE DISPATCH OF SOLAR, STORAGE, OR OTHER QF TECHNOLOGIES. DO YOU AGREE?

A. Yes. As long as variable resources are providing flexibility to DESC in such a way that there is no need to hold additional reserves, then those specific resources should not be charged a VIC as they are not increasing system costs.

Q. DOES THIS CONCLUDE YOUR REBUTTAL TESTIMONY?

A. Yes.